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Anatomy and Relationships of *Temnoconcha brasiliana* Dall

By KENNETH J. BOSS[1] AND VIDA C. KENK[2]

The genus *Temnoconcha* has been previously known only from the holotype of the type species, *T. brasiliana* Dall, which is figured herein for the first time. During the course of a revisionary study of the family Tellinidae, additional specimens of this species were found, including a single specimen suitable for dissection. The following notes were prepared to clarify the taxonomic position of the genus within the family and to present the known distribution of fossil and recent species in the genus.

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ABBREVIATIONS

MCZ—Museum of Comparative Zoology, Harvard University
IMBPR—Institute of Marine Biology, Puerto Rico

[1] United States Fish and Wildlife Service, Washington, D.C.
[2] Museum of Comparative Zoology, Harvard University, Cambridge, Mass.

USNM—United States National Museum
BMNH—British Museum (Natural History)

Systematic Notes

In 1921, Dall described *Psammacoma brasiliana,* creating for it a new section, *Temnoconcha,* on the basis of its unusual sculpture. The type locality of *brasiliana* is São Sebastian Island, São Paulo, Brasil. The holotype (USNM, no. 333023) measures 35 mm. in length, 23 mm. in height, and 8 mm. in width. The shell is characterized by finely incised and closely set transverse sculpture which crosses the external surface of the valves from a high point along the anterior dorsal margin to a low point along the ventral and posterior margins. This sculpture is out of phase with the concentric incremental sculpture. This mode of sculpture is also characteristic of the subgenus *Scissula* (type species, *Tellina decora* Say 1826 [= *Tellina similis* Sowerby 1806]). As *Temnoconcha brasiliana* does not possess lateral teeth in either valve, it is definitely not tellinoid, but macomoid.

Since *Temnoconcha brasiliana* is outwardly similar to *Tellina similis,* some confusion has resulted in the identification of the former species. For example, *brasiliana* was probably first seen by d'Orbigny, as in his collection, which is preserved in the British Museum (Natural History), specimens of Dall's species are labeled '*Tellina similis* Sowerby.' Plainly, d'Orbigny (1822; 1845; 1853) did not know Sowerby's species, for in 1842 he proposed the name *Tellina caribaea* for the common West Indian species which Sowerby had previously described as *similis.*

In his original description of *Temnoconcha brasiliana,* Dall noted the finer points of the hinge dentition, indicating that it consists of only two cardinal teeth in each valve. They depart from the usual macomoid pattern in that both cardinals in the right valve are bifid (see pl. 5, fig. c) while in the left valve, the anterior cardinal is bifid and the single posterior cardinal is laminate. Recently, Olsson (1961) noticed the same configuration in the Eastern Pacific species, *Tellina cognata* Adams 1852 (= *Tellina concinna* Adams 1852) and erected a new genus, *Psammothalia* with *cognata* as its type species. The name *Psammothalia* is therefore a junior synonym of *Temnoconcha* Dall. Olsson gave in the synonymy of *cognata* the various

genera and subgenera to which this species had been assigned previously, thus illustrating that many authors were aware of the peculiar affinities of *cognata.* The species was referred to *Psammobia* by Reeve, *Quadrans* by Dall, *Scissula* by Hertlein and Strong, and *Macoma* by Smith. Certainly, there is no question that *cognata* and *brasiliana* belong to the same group and that they are extremely closely related. Differences between the two species are rather difficult to discern, but they are apparently distinguishable by the thickness of the valves and the width of the shell (see table of measurements). In *brasiliana,* the umbo appears to be farther behind the middle, the shell is more compressed, and the individual valves are thinner than in *cognata.*

According to Olsson (1961), *cognata* is rather common and is widely distributed in the eastern Pacific, being found from Mexico to northern Peru. It is also represented in the Pliocene of Ecuador, and a fossil species in the Miocene of Ecuador appears in the ancestry of *cognata.* Specimens which Olsson referred to as occurring in the Gulf of Mexico have been studied by the authors and are *brasiliana.*

In addition to the original type locality given by Dall for *brasiliana,* the following records of specimens examined are listed and the range of this species is extended:

PUERTO RICO: Punta Algorrobo; Mayagüez (both IMBPR).

LESSER ANTILLES: Matura Bay, Trinidad; 2 miles S of Fort George, Scarborough, Tobago, in 36 fathoms (both MCZ).

HONDURAS: 17 miles NE of Lake Taratasca (Steger).

PANAMA: mouth of Rio Coclé del Norte.

VENEZUELA: 4.3 km. W of Barcelona (both USNM).

SURINAM: Paramaribo; Braams Punt, E of mouth of Surinam River (both Altena).

BRASIL: Praia Comprida, Vitoria, Estado do Espirito Santo (MCZ).

Temnoconcha has recently been collected in the Pleistocene of Surinam by Altena and the fossil species, *Tellina* (*Scissula*) *cercadica* Maury (1917) from the Miocene of Santo Domingo appears to be an ancestor of *brasiliana. Temnoconcha brasiliana* is apparently widely dispersed but rare.

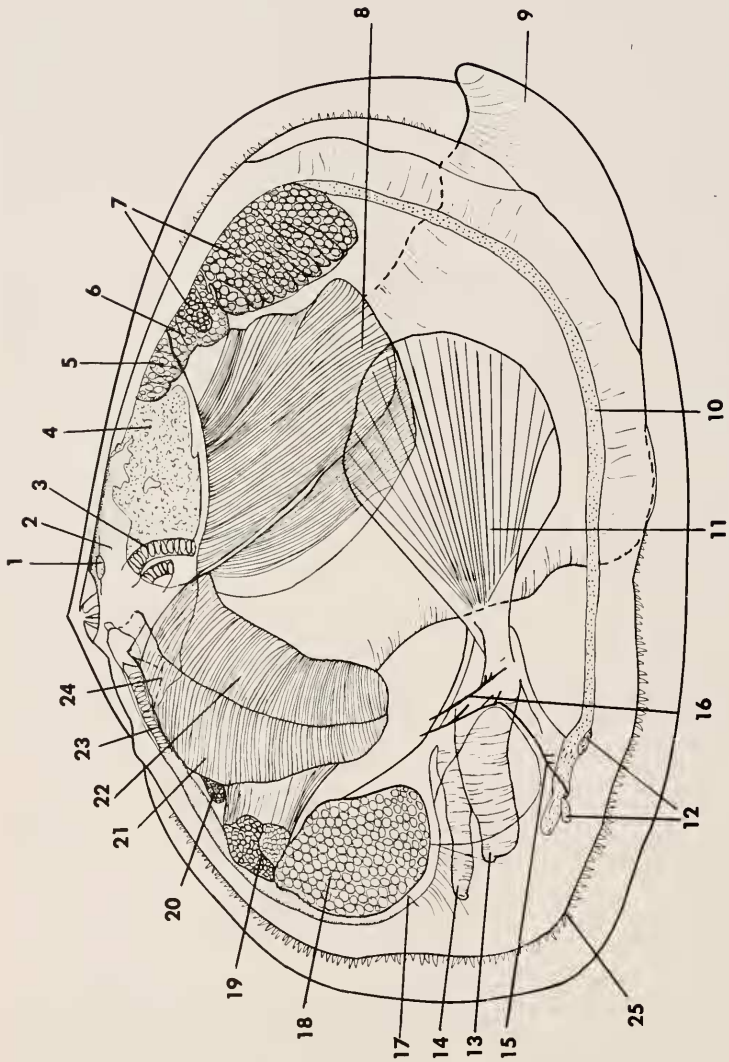

Plate 56

Plate 56

Semidiagrammatic illustration of the anatomy of *Temnoconcha brasiliana*. Specimen with the right valve removed to show general external structural features.

1. medial muscle.
2. gonad.
3. intestine.
4. digestive gland.
5. anterior pedal retractor muscle.
6. pedal protractor muscle.
7. anterior adductor muscle.
8. labial palps.
9. foot.
10. pallial line.
11. siphonal retractor muscle.
12. cruciform muscle.
13. incurrent siphon.
14. excurrent siphon.
15. nerve to the cruciform muscle.
16. nerve to the siphonal retractor muscles.
17. anus.
18. posterior adductor muscle.
19. posterior retractor muscle.
20. kidney.
21. outer demibranch.
22. inner demibranch.
23. rectum.
24. pericardium.
25. tentacles of mantle.

length	height	width	
cognata			
44.0 mm.	29.5 mm.	7.0 * mm.	Holotype of *cognata*, MCZ 186304
38.0	25.0	11.0	Lectotype of *concinna* Adams, MCZ 186302
37.5	24.5	10.5	Paratype of *concinna* Adams, MCZ 186303
53.7	35.8	15.1	Tumbez, Peru
65.5	41.0	9.0 *	Zorritos, Peru
brasiliana			
35.0	23.0	8.0	Holotype of *brasiliana*, USNM 333023
28.0	19.5	7.5	Punta Algorrobo, Puerto Rico
29.0	10.0	—	d'Orbigny Collection (BMNH), no locality
23.5	16.0	—	" " " "
44.0	30.0	5.0 **	" " " "

* semiwidth, right valve only; ** semiwidth, left valve only.

Anatomy

The mantle is thin and transparent over most of its surface but is thickened and muscular at its periphery where it attaches to the valves. It is united dorsally beneath the hinge line of the shell but open ventrally, except at the formation of the cruciform muscle and no specialized pedal gape is formed. As in other macomoids (Yonge, 1957), the mantle margin is differentiated into outer, middle, and inner lobes. Along the postero-ventral border of the mantle, the middle lobe is provided with small, elongate, transparent, and pointed tentacles (pl. 56). Shorter tentacles are present along the anterior dorsal margin of the edge of the mantle. A mantle fold or ridge, similar to that described by Yonge (1949) for *Abra* and *Scrobicularia,* extends from the vicinity of the cruciform muscle anteriorly to form a ventral channel (pl. 57 and pl. 58). The origin of the bilateral fan-shaped siphonal muscle is impressed as a muscle scar, called the pallial sinus, on the internal surface of each valve. The siphonal muscles are slightly asymmetric with those of the left side being somewhat larger. In consequence of this asymmetry, the anterior margin of the pallial sinus in the left valve is closer to the anterior adductor muscle scar. The siphonal musculature becomes confluent with the mantle musculature postero-ventrally; the posterior confluence of the pallial sinus and the pallial line in each valve reflects this anatomical feature.

The siphons are free along most of their length and are united basally. They are not tentaculate distally. At the proximal opening of the incurrent siphon where the inflow of water into the mantle cavity occurs, a right unilateral siphonal organ and bilaterally paired parasiphonal organs are found (pls. 57 and 58). The siphonal organ is thickened, plicate, and 'cushiony' and probably serves a function similar to that of the osphradium of gastropods. The paired parasiphonal organs, previously called 'valvule palleale' by Pelseneer (1911) or 'mantle folds' by Yonge (1949), are thin and phylloid. They function to prevent pseudofeces from being swept onto the gills by the strong incoming flow of water. Both these organs are attached to the inner surface of the walls of the siphonal musculature, and both are innervated by nerves from the visceral ganglion.

The cruciform muscle subtending the siphonal apparatus is well developed and possesses the small cruciform organs discussed and figured by Yonge (1949). The posterior portion of the cruciform muscle is divided near its origin, forming two small scars on each valve; the anterior portion has a single origin. Concordant with the asymmetry of the siphonal musculature, the anterior and posterior cruciform muscle scars are closer together on the left valve than on the right.

The anterior and posterior adductor muscles are large and subequal in size. The anterior adductor is subdivided into two portions of which the ventral is the larger; the muscle is irregularly elongate and semilunate in shape. The posterior adductor muscle tends to be subquadrate. Mediodorsally there is a small muscle which splays out in the mantle lateral to the convoluted intestine and attaches the visceral mass to the valves. This muscle is structurally different from but may be functionally similar to the medial adductor muscle which Yonge (1949) illustrated connecting the two valves and passing under the postero-dorsal caecum of the stomach in other tellinoids. This medial muscle leaves a distinct, variously formed scar just anterior and ventral to the cardinal hinge plate in both valves.

The pedal musculature consists of anterior and posterior pedal retractors and of a pedal protractor; all the complex of pedal musculature inserts into the foot. The anterior pedal retractor originates along the anterior dorsal margin of the

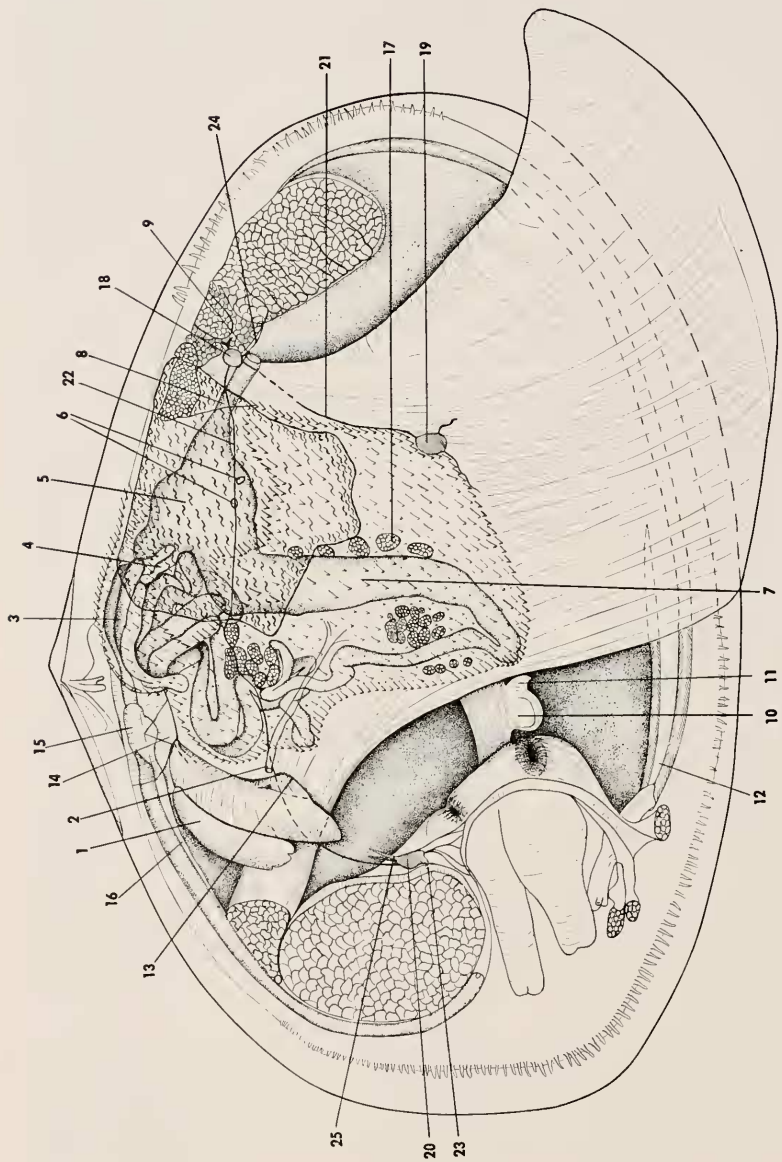

Plate 57

Plate 57.

Semidiagrammatic illustration of the anatomy of *Temnoconcha brasiliana*. Specimen with the mantle, ctenidia and palps removed to show internal features. Ovary indicated by check marks, digestive gland by wavy lines.

1. kidney.
2. oviduct.
3. convoluted portion of the intestine.
4. appendix.
5. stomach.
6. ducts to digestive gland on right side of stomach.
7. mid-gut and style sac.
8. esophagus.
9. mouth.
10. siphonal organ.
11. parasiphonal organ.
12. ventral channel.
13. nephroproct.
14. auricle.
15. ventricle.
16. posterior aorta.
17. transverse muscle (one of many).
18. cerebropleural ganglion.
19. pedal ganglion.
20. visceral ganglion.
21. cerebropleural-pedal connective.
22. cerebropleural-visceral connective.
23. nerve to posterior adductor.
24. nerve to anterior adductor.
25. branchial nerves.

valve and inserts deeply in the foot. The posterior pedal retractor originates dorsal to the posterior adductor muscle and courses anteriorly to insert in the foot beneath the fibers of the pedal protractor and intermeshing with the fibers of the anterior pedal retractor. The pedal protractor has a diffuse origin along the anterior dorsal margin between the anterior adductor muscle and the anterior pedal retractor. The pedal protractor splays out in a superficial insertion immediately beneath the heavy epidermal tissue of the foot. The foot itself is rather large and laterally compressed; its well developed retractor, protractor, and many transverse muscles reflect its strength and extensibility.

The gills of *Temnoconcha* are typically macomoid in form and placement. They consist of a dorsally upturned outer demibranch and a ventral inner demibranch. The individual demibranchs are united medially, and the combined demibranchs of the right and left ctenidia are united distally along the ventral surface of the posterior retractor muscle. Contiguous with the proximal boundary of the inner demibranch are the large labial palps which are similar to those of other macomoids (Thiele, 1886). The filter feeding mechanisms of *brasiliana* are probably similar in function to those of *Macoma secta* as described by Kellogg (1915).

Plates 57 and 59 illustrate the structure of the alimentary canal. At the median union of the right and left pairs of labial palps is the mouth. A short esophagus leads to the stomach which is enveloped by the digestive gland. The stomach in the Tellinidae has been described in detail by Graham (1949) and Purchon (1960). In *brasiliana,* the style sac and mid-gut are united and leave the stomach postero-ventrally. The stomach has right and left ventral caeca, a dorsal pouch, and a postero-dorsal appendix. Two large ducts from the digestive gland enter the right ventral caecum and a single duct enters the left ventral caecum. The gastric shield differs markedly from that of *Tellina tenuis* as illustrated by Yonge (1949) in that it extends into the esophagus, the dorsal pouch, and the posterior portion of the stomach dorsal to the appendix. The intestine is tortuously convoluted before it passes through the ventricle of the heart in the pericardial cavity. The rectum extends from the pericardial cavity along the dorsal margin above the

ctenidium and the posterior adductor muscles, forming the terminal anus near the opening of the excurrent siphon. In the specimen dissected, the intestine and rectum contained coin-shaped fecal pellets (length/breadth ratio=0.5) which upon examination were found to consist of unidentifiable plant remains, including diatoms, and some sand grains with detritus, indicating the normal filtering habit of a benthic deposit feeder.

The heart is located postero-dorsally in the pericardial cavity. It is simple in form, consisting of laterally paired thin-walled auricles and a single thick-walled median ventricle through which the rectum passes. An aorta extends posteriorly from the ventricle along the ventral side of the rectum. The relatively large kidney which is postero-ventral to the heart connects with the pericardium via the laterally paired ciliated reno-pericardial funnels. Waste products from the kidney are expelled via the nephroproct.

Temnoconcha appears to be dioecious though only a female specimen was available for dissection. The large ovary is imbedded in the foot, surrounds the style sac, mid-gut, and the ventral portion of the digestive gland and extends dorsally and superficially over the convoluted portion of the intestine into the mantle tissue. The extension of the gonad into the mantle tissue has been reported in certain species of *Arca* and *Chama* (White, 1942). A long and branched oviduct leads to the genital pore which opens near the nephroproct in a urogenital sinus which is coextensive with the mantle cavity. Eggs in the ovary were 130–140 μ in diameter and quite yolky, indicating lecithotrophic larval development and a short pelagic stage. Odhner (1912) has discussed in detail the nephridial system and its relationship with the circulatory and reproductive systems in *Macoma balthica,* which in many respects is similar to *brasiliana.*

The structure of the nervous system of *Temnoconcha* is similar to that of *Psammobia* as described by Durvernoy (1854). The cerebropleural ganglia, located on the inner surface of the anterior adductor muscle, are united via a cerebro-pleural commissure. Anteriorly the ganglia give rise to a branching complex of nerves which innervates the anterior adductor muscle as well as the anterior pallial musculature. The cerebropleural-pedal connectives extend ventrally from the cerebropleural

Plate 58

Ventral posterior view of *Temnoconcha brasiliana* to show the structural features of the cruciform muscle and the siphonal apparatus.

1. tentacles.
2. rectum.
3. anus.
4. posterior adductor muscle.
5. excurrent siphon.
6. incurrent siphon.
7. cruciform muscle.
8. cruciform organs.
9. mantle fold forming ventral channel.
10. siphonal organ.
11. parasiphonal organ.
12. base of incurrent siphon.
13. foot.

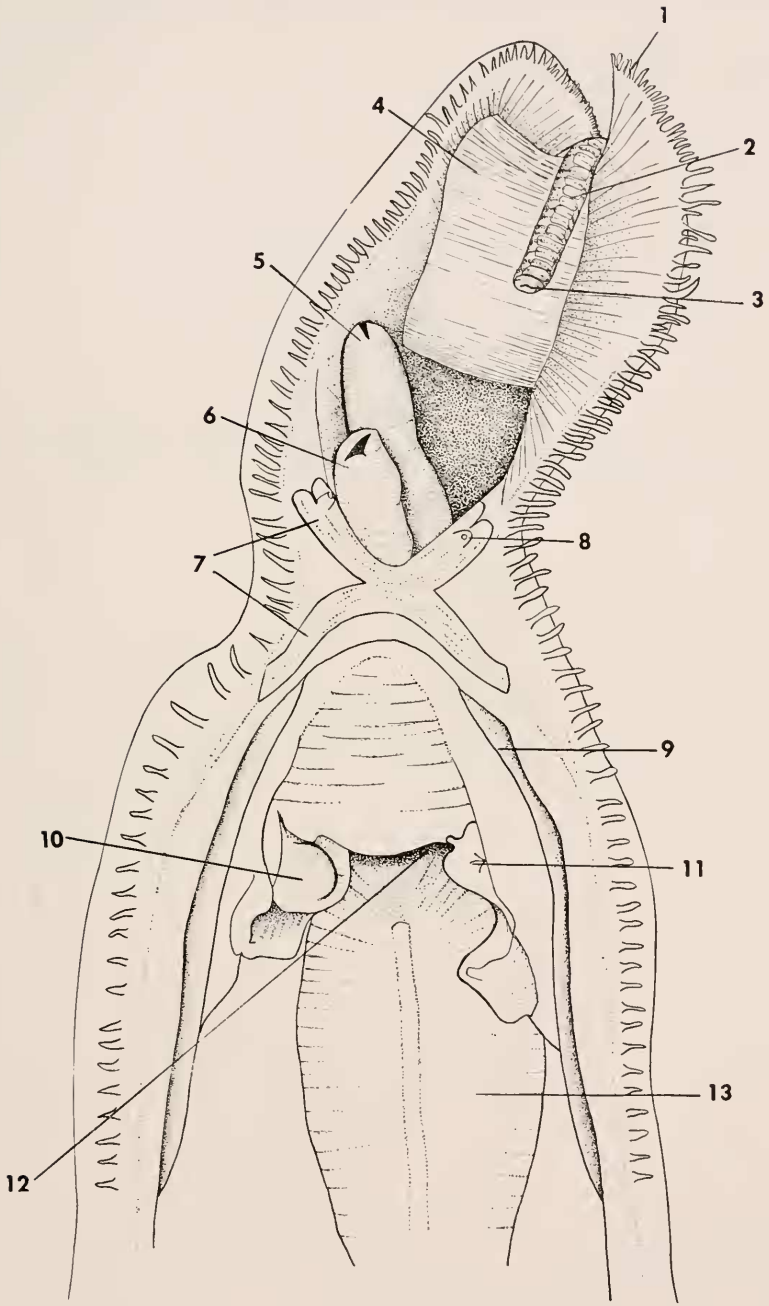

Plate 58

Plate 59

Upper figure. The style sac and stomach of *Temnoconcha brasiliana* viewed from the right side. Lower figure. The gastric shield of *Temnoconcha brasiliana* viewed from the right side.

1. style sac and mid-gut.
2. crystalline style.
3. appendix.
4. esophagus.
5. right ventral caecum.
6. gastric teeth.
7. extension to dorsal pouch.
8. extension to esophagus.
9. extension to style sac.
10. extension toward postero-dorsal appendix.

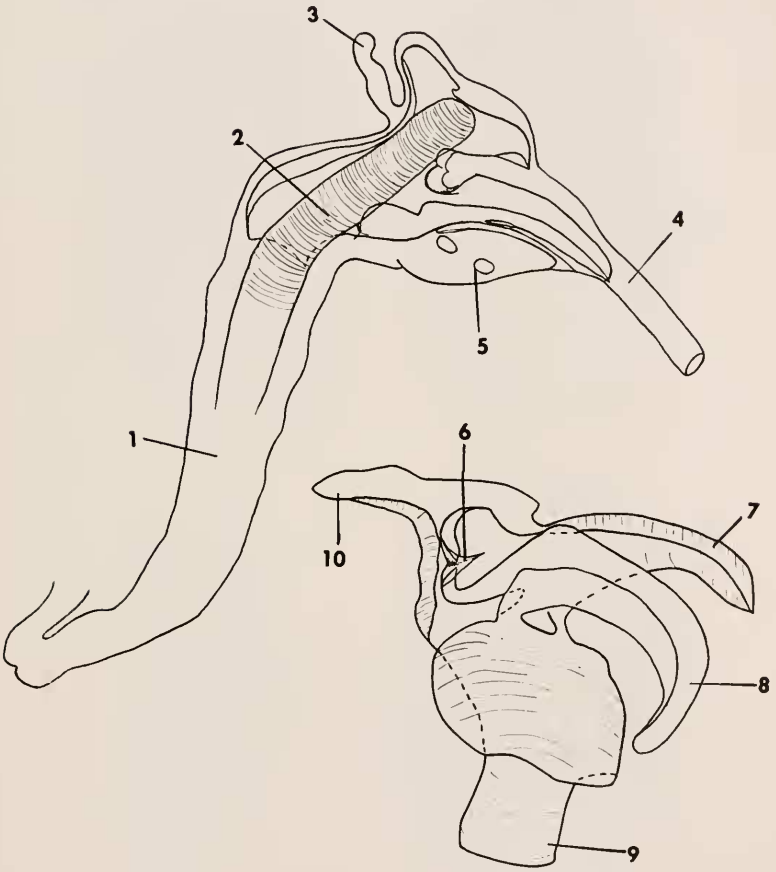

Plate 59

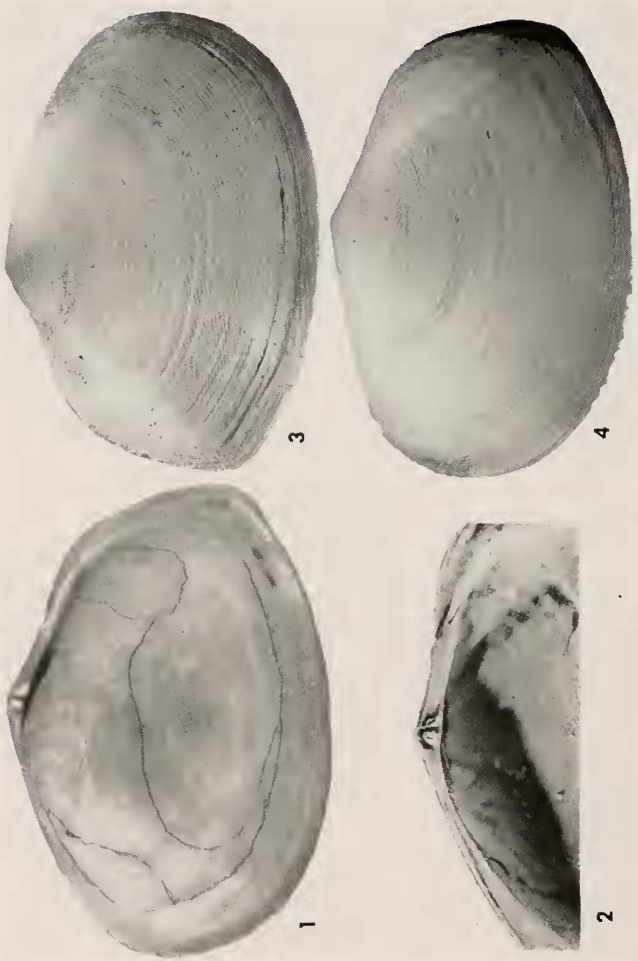

Plate 60

Plate 60

Fig. 1. Internal view of the right valve of the holotype of *Temnoconcha brasiliana* Dall, showing configuration of the pallial sinus (1.8×).

Fig. 2. Internal view of a portion of the right valve of *Temnoconcha brasiliana* Dall, showing the bifid cardinal teeth and absence of lateral teeth (specimen from the d'Orbigny collection, BMNH; 2.8×).

Fig. 3. External view of the right valve of the holotype of *Temnoconcha brasiliana* Dall (1.8×).

Fig. 4. External view of the left valve of the holotype of *Temnoconcha brasiliana* Dall (1.8×).

ganglia to the paired but closely juxtaposed pedal ganglia. From the pedal ganglia numerous branches innervate portions of the pedal retractor and protractor musculature as well as portions of the viscera extending into the foot. Arising from the cerebropleural ganglia and coursing posteriorly are the laterally paired cerebropleural-visceral connectives which communicate with the nearly fused, compacted visceral ganglia near the inner surface of the posterior adductor muscle. Paired nerves are given off to the ctenidia from the visceral ganglia and the posterior adductor muscle. The largest pair of nerves extends ventrally and gives off branches to the mantle, the siphonal musculature, the siphonal and parasiphonal organs, and the cruciform muscle.

Relationships

The affinities of *Temnoconcha* with the family Tellinidae are clearly shown by anatomical characters such as the formation of the gills and the muscles, the union of the style sac and the mid-gut, the simple structure of the heart, the dioecious condition of the reproductive system and the specialization of the nervous system. Within the family, the subfamilies Tellininae and Macominae may be distinguished by the presence or absence of lateral teeth, the relative size of the ctenidia and the labial palps, the degree of convolution of the distal portion of the intestine and the structure of the cruciform organs. The genus *Temnoconcha* has macomoid shell characters but is distinctive in the possession of two bifid cardinal teeth in the right valve. As in *Macoma,* the palps of *Temnoconcha* are larger than the ctenidia, the distal portion of the intestine is extensively convoluted and the cruciform organs open externally via tubular papillae. Therefore, *Temnoconcha* appears to belong to the subfamily Macominae.

Temnoconcha differs from other members of the Tellinidae for which the anatomy is known in the following characters: 1) the gastric shield is very complex; 2) the medial muscle splays out over the viscera dorsally rather than passing beneath the postero-dorsal appendix of the stomach; 3) the posterior portion of the cruciform muscle has a double rather than a single origin; and 4) the reproductive tissue extends into the mantle.

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